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Re Applic of	Eric P. Solecky et al.
Docket No.	FIS920010256US1
Serial No.	09/996,399
Filing Date	November 29, 2001
Attorney	Steven Capella

Attached: Appeal Brief in Triplicate

PLEASE DELIVER TO:

EXAMINER: Tung S. Lau
ART UNIT: 2863
FAX NO: 703-872-9306
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INTERNATIONAL BUSINESS MACHINES CORPORATION

Intellectual Property Law
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I hereby certify that this correspondence is being deposited by FACSIMILE to the Commissioner for Patents, PO Box 1450, Alexandria, VA 22313-1450 on March 18, 2004 by Colleen J. Dew.

Colleen J. Dew 3/18/04

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Group Art Unit 2863

In re application of	:	March 18, 2004
Eric P. Solecky et al.	:	Examiner: Tung S. Lau
Serial No. : 09/996,399	:	
Filed: November 29, 2001	:	IBM Corporation Dept. 18G/Bldg, 300-482
Title: APPARATUS AND METHOD FOR CHARACTERIZING FEATURES AT SMALL DIMENSIONS	:	2070 Route 52 Hopewell Junction, NY 12533-6531

APPEAL BRIEF

Commissioner for Patents
Alexandria, VA 22313-1450

Sir:

This is an appeal from the Final Rejection of claims 6-7, 9-15 and 17-35. A correct copy of the claims is attached in the Appendix.

Real Party in Interest

The real partles in interest is International Business Machines Corporation per an assignment recorded in the US Patent and Trademark Office at Reel/Frame: 012340/0450 on November 29, 2001.

Related Appeals and Interferences

None.

Status of Claims

Claims 6-35 are pending. Claims 8 and 16 are objected to as being dependent on rejected base claims, but would be allowable if rewritten in independejnt form.

Status of Amendments

No amendments after Final Rejection have been submitted.

Summary of Invention

The invention centers on methods, systems, apparatus and computer programs for providing improved resolution and prediction of performance behavior and/or physical characteristic of structural features using feedback information which is provided as a function of position over respective features. The invention is especially important in the improvement and extension of resolution capability for CD-SEM measurements to dimensions below 180 nanometers. Thus, for example, the invention is useful for better determining whether a hole in a resist pattern for forming contacts is truly open thereby improving yield and process condition discrimination. See the specification at page 2, lines 15-22; page 3, lines 2-6; page 4, lines 4-19 and the disclosure of US Patent 6185323 which is incorporated into the present application by reference.

Issues

1. Whether claims 6-7, 9-15, 17-32 are patentable under 35 USC 102(e) over Kikuchi (US Patent Application 2002/0042664).

2. Whether claims 33-35 are patentable under 35 USC 103(a) over Kikuchi (US Pat. App. 2002/0042664) in view of Kim (US Pat. 6,581,023).

Grouping of Claims

Regarding issue 1, claims 11, 13, 20, and 22 are further separately patentable for the reasons stated below and claims 15, 24, and 30 are also further separately patentable. Otherwise, the claims stand or fall together within each respective issue identified above.

Argument

1. Whether claims 6-7, 9-15, 17-32 are patentable under 35 USC 102(e) over Kikuchi (US Patent Application 2002/0042664).

Kikuchi discloses a process for improved overlay metrology wherein the position of alignment marks are determined and weighted to account for linear and non-linear distortion between respective shots.

Kikuchi does not disclose or suggest use of feedback elements from said features which vary as a function of position over such features as required by the present claims in both the calibration database and in the data provided from the target features. The portions of Kikuchi (page 3, 30-36 and Fig. 7, 8, 10, 11, 14, 15, 18) cited in the office action refer to distortion in the wafer as reflected by the position of the target features. These portions of Kikuchi do not relate to any property of the features themselves which changes as a function of position over the features. Kikuchi is simply concerned with feature position which is then

correlated to wafer distortion.

Kikuchi does not disclose the prediction of etchability as in present claims 11, 13, 20, and 22. The portions of the specification (page 2-3 sections 0025-0030) cited in the office action are silent regarding etchability, much less etchability of target features. Kikuchi is concerned with overlay misalignment resulting from wafer distortion. Kikuchi is not concerned whether a pattern can be actually transferred to an underlying layer, but only that whatever pattern one is attempting to transfer is aligned as correctly as possible.

Kikuchi does not disclose or suggest the use of SEM secondary electron emission as required by present claims 15, 24, and 30. Regarding method claims 15 and 24, appellants submit that no where is it contemplated in Kikuchi to use SEM data in the Kikuchi process. Thus, a process claiming to use such SEM data would not be considered obvious from Kikuchi. Regarding apparatus claim 30, appellants submit that apparatus claim requires a scanning electron beam means for obtaining information elements. Nothing in Kikuchi discloses or suggests an apparatus with such means.

2. Whether claims 33-35 are patentable under 35 USC 103(a) over Kikuchi (US Pat. App. 2002/0042664) in view of Kim (US Pat. 6,581,023).

Kikuchi discloses a process for improved overlay metrology wherein the position of alignment marks are determined and weighted to account for linear and non-linear distortion between respective shots.

Kikuchi does not disclose or suggest use of feedback elements from said features which vary as a function of position over such features as required by

the present claims in both the calibration database and in the data provided from the target features. The portions of Kikuchi (page 3, 30-36 and Fig. 7, 8, 10, 11, 14, 15, 18) cited in the office action refer to distortion in the wafer as reflected by the position of the target features. These portions of Kikuchi do not relate to any property of the features themselves which changes as a function of position over the features. Kikuchi is simply concerned with feature position which is then correlated to wafer distortion.

Kikuchi does not disclose the prediction of etchability as in present claims 33-35. The portions of the specification (page 2-3 sections 0025-0030) cited in the office action are silent regarding etchability, much less etchability of target features. Kikuchi is concerned with overlay misalignment resulting from wafer distortion. Kikuchi is not concerned whether a pattern can be actually transferred to an underlying layer, but only that whatever pattern one is attempting to transfer is aligned as correctly as possible.

Kim (US 6581023) discloses a method of critical dimension measurement using an SEM. The problem addressed by Kim relates to whether individual features are imaged to target critical dimensions in a lithography process on a per layer basis. Kim is not concerned with overlay metrology or overlay alignment which is the subject of Kikuchi. Even if one were to use the measurement techniques of Kim in the method of Kikuchi, the result would be a disregard of any data regarding parameters such as feature depth since Kikuchi is only concerned with the location of target features. Thus, the combination of the teachings of Kim with those of Kikuchi, to the extent such a combination would be motivated to those of ordinary skill in the art, would not result in the claimed invention.

Conclusion

For the above reasons, appellants submit that the claims are patentable over the prior art of record and that the application is in condition for allowance. Such allowance is earnestly and respectfully solicited.

Respectfully submitted,
Eric P. Solecky et al.

By _____
Steven Capella, Attorney
Reg. No. 33,086
Telephone: 845-894-3669

THE CLAIMS

1 -5. (cancelled)

6. A method for evaluation of target structural features on a substrate, said method comprising:

(a) providing a calibration database comprising:

(i) information elements selected from the group consisting of (A) information elements describing a functional performance characteristic of respective reference structural features on a substrate, and (B) information elements describing a physical characteristic of each of said respective reference structural features, or both types of information elements, and

(ii) information elements describing feedback from said respective reference structural features as a function of position over each of said respective reference structural features,

(b) providing at least one weighting function as a function of position over each of said respective reference structural features and at least one correlation function as a function of position over each of said respective reference structural features, wherein a plurality of weighting functions and/or correlation functions is provided,

(c) determining a combination of weighting function and correlation

function from said provided which provide a desired degree of correlation between said information elements (i) and (ii) for respective reference structural features,

(d) providing information elements describing feedback from said target structural features as a function of position over each of said respective target structural features on said substrate, and

(e) applying said combination of weighting function and correlation function to said target structural feature information elements to predict said functional performance characteristic of respective target structural features and/or to describe said physical characteristic of respective target structural features.

7. The method of claim 6 wherein a plurality of weighting functions and a plurality of correlation functions are provided in step (b).

8. The method of claim 6 wherein said weighting functions are selected from the group consisting of continuous functions and discontinuous functions.

9. The method of claim 6 wherein a value of said weighting function of said determined combination of step (c) is multiplied with a value of a respective information element in step (e).

10. The method of claim 6 wherein said calibration database includes information elements describing a functional performance characteristic of respective reference structural features on a substrate, and said functional performance characteristic is predicted in step (e).

11. The method of claim 10 wherein said functional performance characteristic is the etchability across said target feature.

12. The method of claim 6 wherein said structural features are holes in a resist layer on said substrate.

13. The method of claim 12 wherein said functional performance characteristic is a response of each respective hole to an etching protocol.

14. The method of claim 6 wherein all of said information elements are embodied in a computer-readable medium and steps (c) and (e) are performed using a computer.

15. The method of claim 6 wherein said feedback of steps (a) and (e) comprises secondary electron emission from said structural features upon exposure to a scanning electron beam.

16. The method of claim 6 wherein steps (c) and (e) include performance of linear regression analysis.

17. A method for evaluation of target structural features on a substrate, said method comprising:

(a) providing information elements describing feedback from said target structural features as a function of position over each of said respective target structural features on said substrate,

(b) applying a combination of a weighting function and a correlation function to said target structural feature information elements to predict a functional performance characteristic of respective target

structural features and/or to describe a physical characteristic of respective target structural features.

18. The method of claim 17 wherein a value of said weighting function is multiplied with a value of a respective information element in step (b).

19. The method of claim 17 wherein a functional performance characteristic is predicted in step (b).

20. The method of claim 19 wherein said functional performance characteristic is the etchability across said target feature.

21. The method of claim 17 wherein said structural features are holes in a resist layer on said substrate.

22. The method of claim 21 wherein said functional performance characteristic is a response of each respective hole to an etching protocol.

23. The method of claim 17 wherein all of said information elements are embodied in computer-readable media and steps (c) and (e) are performed using a computer.

24. The method of claim 17 wherein said feedback comprises secondary electron emissions from said structural features upon exposure to a scanning electron beam.

25. A system for evaluation of target structural features on a substrate, said system comprising:

(a) a calibration database in a computer-readable medium, said database comprising:

(i) information elements selected from the group consisting of information elements describing a functional performance characteristic of respective reference structural features on a substrate and information elements describing physical analysis of each of said respective reference structural features, and

(ii) information elements describing feedback from said respective structural features as a function of position over each of said respective reference structural features,

(b) information elements in a computer-readable medium corresponding to at least one weighting function as a function of position over each of said respective reference structural features, and at least one correlation function as a function of position over each of said respective reference structural features, wherein a plurality of weighting functions and/or correlation functions is provided,

(c) means for determining a combination of weighting function and correlation function from said provided which provide a desired degree of correlation between said information elements (i) and (ii) for respective reference structural features,

(d) information elements in a computer-readable medium describing feedback from said target structural features as a function of position over each of said respective target structural features on said substrate,

(e) means for applying said combination of weighting function and correlation function to said target structural feature information elements to predict said functional performance characteristic of respective target structural features and/or to describe said physical characteristic of respective target structural features.

26. The system of claim 25 wherein said means (c) comprises executable code stored in a computer readable medium and a computer capable of executing said code.

27. The system of claim 25 wherein said means (e) comprises executable code stored in a computer readable medium and a computer capable of executing said code.

28. An apparatus for evaluation of target structural features on a substrate, said apparatus comprising:

(a) information elements in a computer-readable medium describing feedback from said target structural features as a function of position over each of said respective target structural features on said substrate,

(b) means for applying a combination of weighting function and correlation function to said target structural feature information

elements to predict a functional performance characteristic of respective target structural features and/or to describe a physical characteristic of respective target structural features.

29. The apparatus of claim 28 further comprising means for obtaining said information elements.

30. The apparatus of claim 29 wherein said means for obtaining said information elements includes a scanning electron beam.

31. A computer program stored in a computer-readable medium, said program performing a method of evaluating target structural features on a substrate, said method comprising:

(a) creating a calibration database comprising:

(i) information elements selected from the group consisting of (A) information elements describing a functional performance characteristic of respective reference structural features on a substrate, and (B) information elements describing a physical characteristic of each of said respective reference structural features, or both types of information elements, and

(ii) information elements describing feedback from said respective reference structural features as a function of position over each of said respective reference structural features,

(b) providing at least one weighting function as a function of position over each of said respective reference structural features and at least one correlation function as a function of position over each of said respective reference structural features, wherein a plurality of weighting functions and/or correlation functions is provided,

(c) determining a combination of weighting function and correlation function from said provided which provide a desired degree of correlation between said information elements (i) and (ii) for respective reference structural features,

(d) obtaining information elements describing feedback from said target structural features as a function of position over each of said respective target structural features on said substrate, and

(e) applying said combination of weighting function and correlation function to said target structural feature information elements to predict said functional performance characteristic of respective target structural features and/or to describe said physical characteristic of respective target structural features.

32. A computer program stored in a computer-readable medium, said program performing a method of evaluating target structural features on a substrate, said method comprising:

(a) obtaining information elements describing feedback from said target structural features as a function of position over each of said respective target structural features on said substrate,

(b) applying a combination of a weighting function and a correlation function to said target structural feature information elements to predict a functional performance characteristic of respective target structural features and/or to describe a physical characteristic of respective target structural features.

33. The method of claim 6 wherein said physical characteristic is a depth profile across said structural feature and said functional performance characteristic is etchability across said structural feature.

34. The system of claim 25 wherein said physical characteristic is a depth profile across said structural feature and said functional performance characteristic is etchability across said structural feature.

35. The computer program of claim 31 wherein said physical characteristic is a depth profile across said structural feature and said functional performance characteristic is etchability across said structural feature.

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TRANSMITTAL OF APPEAL BRIEF (Large Entity)	Docket No. FIS920010256US1

In Re Application Of:

Eric P. Solecky et al.

Serial No.	Filing Date	Examiner	Group Art Unit
09/996,399	November 29, 2001	Tung S. Lau	2863

Invention:

APPARATUS AND METHOD FOR CHARACTERIZING FEATURES AT SMALL DIMENSIONS

TO THE COMMISSIONER FOR PATENTS:

Transmitted herewith in triplicate is the Appeal Brief in this application, with respect to the Notice of Appeal filed on

The fee for filing this Appeal Brief is: **$330.00**

☐ A check in the amount of the fee is enclosed.

☒ The Director has already been authorized to charge fees in this application to a Deposit Account.

☒ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. **09-0458, FI-070**

Signature

Dated: **March 18, 2004**

Steven Capella, Registration No. 33,086
International Business Machines Corporation
2070 Route 52
Hopewell Junction, New York 12533
845-894-3669

I certify that this document and fee is being Faxed on 3/18/2004 and is addressed to the Commissioner of Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Colleen J. Dew

Signature of Person Faxed Correspondence

Colleen J. Dew

Typed or Printed Name of Person Faxed Correspondence

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I hereby certify that this correspondence is being deposited by FACSIMILE to the Commissioner for Patents, PO Box 1450, Alexandria, VA 22313-1450 on March 18, 2004 by Colleen J. Dew.

Colleen J. Dew 3/18/04

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Group Art Unit 2863

In re application of	:	March 18, 2004
Eric P. Solecky et al.	:	Examiner: Tung S. Lau
Serial No. : 09/996,399	:	
Filed: November 29, 2001	:	IBM Corporation Dept. 18G/Bldg, 300-482
Title: APPARATUS AND METHOD FOR CHARACTERIZING FEATURES AT SMALL DIMENSIONS	:	2070 Route 52 Hopewell Junction, NY 12533-6531

APPEAL BRIEF

Commissioner for Patents
Alexandria, VA 22313-1450

Sir:

This is an appeal from the Final Rejection of claims 6-7, 9-15 and 17-35. A correct copy of the claims is attached in the Appendix.

Real Party in Interest

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Related Appeals and Interferences

None.

Status of Claims

Claims 6-35 are pending. Claims 8 and 16 are objected to as being dependent on rejected base claims, but would be allowable if rewritten in independejnt form.

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Summary of Invention

The invention centers on methods, systems, apparatus and computer programs for providing improved resolution and prediction of performance behavior and/or physical characteristic of structural features using feedback information which is provided as a function of position over respective features. The invention is especially important in the improvement and extension of resolution capability for CD-SEM measurements to dimensions below 180 nanometers. Thus, for example, the invention is useful for better determining whether a hole in a resist pattern for forming contacts is truly open thereby improving yield and process condition discrimination. See the specification at page 2, lines 15-22; page 3, lines 2-6; page 4, lines 4-19 and the disclosure of US Patent 6185323 which is incorporated into the present application by reference.

Issues

1. Whether claims 6-7, 9-15, 17-32 are patentable under 35 USC 102(e) over Kikuchi (US Patent Application 2002/0042664).

2. Whether claims 33-35 are patentable under 35 USC 103(a) over Kikuchi (US Pat. App. 2002/0042664) in view of Kim (US Pat. 6,581,023).

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Regarding issue 1, claims 11, 13, 20, and 22 are further separately patentable for the reasons stated below and claims 15, 24, and 30 are also further separately patentable. Otherwise, the claims stand or fall together within each respective issue identified above.

Argument

1. Whether claims 6-7, 9-15, 17-32 are patentable under 35 USC 102(e) over Kikuchi (US Patent Application 2002/0042664).

Kikuchi discloses a process for improved overlay metrology wherein the position of alignment marks are determined and weighted to account for linear and non-linear distortion between respective shots.

Kikuchi does not disclose or suggest use of feedback elements from said features which vary as a function of position over such features as required by the present claims in both the calibration database and in the data provided from the target features. The portions of Kikuchi (page 3, 30-36 and Fig. 7, 8, 10, 11, 14, 15, 18) cited in the office action refer to distortion in the wafer as reflected by the position of the target features. These portions of Kikuchi do not relate to any property of the features themselves which changes as a function of position over the features. Kikuchi is simply concerned with feature position which is then

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Kikuchi does not disclose the prediction of etchability as in present claims 11, 13, 20, and 22. The portions of the specification (page 2-3 sections 0025-0030) cited in the office action are silent regarding etchability, much less etchability of target features. Kikuchi is concerned with overlay misalignment resulting from wafer distortion. Kikuchi is not concerned whether a pattern can be actually transferred to an underlying layer, but only that whatever pattern one is attempting to transfer is aligned as correctly as possible.

Kikuchi does not disclose or suggest the use of SEM secondary electron emission as required by present claims 15, 24, and 30. Regarding method claims 15 and 24, appellants submit that no where is it contemplated in Kikuchi to use SEM data in the Kikuchi process. Thus, a process claiming to use such SEM data would not be considered obvious from Kikuchi. Regarding apparatus claim 30, appellants submit that apparatus claim requires a scanning electron beam means for obtaining information elements. Nothing in Kikuchi discloses or suggests an apparatus with such means.

2. **Whether claims 33-35 are patentable under 35 USC 103(a) over Kikuchi (US Pat. App. 2002/0042664) in view of Kim (US Pat. 6,581,023).**

Kikuchi discloses a process for improved overlay metrology wherein the position of alignment marks are determined and weighted to account for linear and non-linear distortion between respective shots.

Kikuchi does not disclose or suggest use of feedback elements from said features which vary as a function of position over such features as required by

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Kikuchi does not disclose the prediction of etchability as in present claims 33-35. The portions of the specification (page 2-3 sections 0025-0030) cited in the office action are silent regarding etchability, much less etchability of target features. Kikuchi is concerned with overlay misalignment resulting from wafer distortion. Kikuchi is not concerned whether a pattern can be actually transferred to an underlying layer, but only that whatever pattern one is attempting to transfer is aligned as correctly as possible.

Kim (US 6581023) discloses a method of critical dimension measurement using an SEM. The problem addressed by Kim relates to whether individual features are imaged to target critical dimensions in a lithography process on a per layer basis. Kim is not concerned with overlay metrology or overlay alignment which is the subject of Kikuchi. Even if one were to use the measurement techniques of Kim in the method of Kikuchi, the result would be a disregard of any data regarding parameters such as feature depth since Kikuchi is only concerned with the location of target features. Thus, the combination of the teachings of Kim with those of Kikuchi, to the extent such a combination would be motivated to those of ordinary skill in the art, would not result in the claimed invention.

Conclusion

For the above reasons, appellants submit that the claims are patentable over the prior art of record and that the application is in condition for allowance. Such allowance is earnestly and respectfully solicited.

Respectfully submitted,
Eric P. Solecky et al.

By _____
Steven Capella, Attorney
Reg. No. 33,086
Telephone: 845-894-3669

THE CLAIMS

1 -5. (cancelled)

6. A method for evaluation of target structural features on a substrate, said method comprising:

(a) providing a calibration database comprising:

(i) information elements selected from the group consisting of (A) information elements describing a functional performance characteristic of respective reference structural features on a substrate, and (B) information elements describing a physical characteristic of each of said respective reference structural features, or both types of information elements, and

(ii) information elements describing feedback from said respective reference structural features as a function of position over each of said respective reference structural features,

(b) providing at least one weighting function as a function of position over each of said respective reference structural features and at least one correlation function as a function of position over each of said respective reference structural features, wherein a plurality of weighting functions and/or correlation functions is provided,

(c) determining a combination of weighting function and correlation

function from said provided which provide a desired degree of correlation between said information elements (i) and (ii) for respective reference structural features,

(d) providing information elements describing feedback from said target structural features as a function of position over each of said respective target structural features on said substrate, and

(e) applying said combination of weighting function and correlation function to said target structural feature information elements to predict said functional performance characteristic of respective target structural features and/or to describe said physical characteristic of respective target structural features.

7. The method of claim 6 wherein a plurality of weighting functions and a plurality of correlation functions are provided in step (b).

8. The method of claim 6 wherein said weighting functions are selected from the group consisting of continuous functions and discontinuous functions.

9. The method of claim 6 wherein a value of said weighting function of said determined combination of step (c) is multiplied with a value of a respective information element in step (e).

10. The method of claim 6 wherein said calibration database includes information elements describing a functional performance characteristic of respective reference structural features on a substrate, and said functional performance characteristic is predicted in step (e).

11. The method of claim 10 wherein said functional performance characteristic is the etchability across said target feature.

12. The method of claim 6 wherein said structural features are holes in a resist layer on said substrate.

13. The method of claim 12 wherein said functional performance characteristic is a response of each respective hole to an etching protocol.

14. The method of claim 6 wherein all of said information elements are embodied in a computer-readable medium and steps (c) and (e) are performed using a computer.

15. The method of claim 6 wherein said feedback of steps (a) and (e) comprises secondary electron emission from said structural features upon exposure to a scanning electron beam.

16. The method of claim 6 wherein steps (c) and (e) include performance of linear regression analysis.

17. A method for evaluation of target structural features on a substrate, said method comprising:

(a) providing information elements describing feedback from said target structural features as a function of position over each of said respective target structural features on said substrate,

(b) applying a combination of a weighting function and a correlation function to said target structural feature information elements to predict a functional performance characteristic of respective target

structural features and/or to describe a physical characteristic of respective target structural features.

18. The method of claim 17 wherein a value of said weighting function is multiplied with a value of a respective information element in step (b).

19. The method of claim 17 wherein a functional performance characteristic is predicted in step (b).

20. The method of claim 19 wherein said functional performance characteristic is the etchability across said target feature.

21. The method of claim 17 wherein said structural features are holes in a resist layer on said substrate.

22. The method of claim 21 wherein said functional performance characteristic is a response of each respective hole to an etching protocol.

23. The method of claim 17 wherein all of said information elements are embodied in computer-readable media and steps (c) and (e) are performed using a computer.

24. The method of claim 17 wherein said feedback comprises secondary electron emissions from said structural features upon exposure to a scanning electron beam.

25. A system for evaluation of target structural features on a substrate, said system comprising:

(a) a calibration database in a computer-readable medium, said database comprising:

(i) Information elements selected from the group consisting of information elements describing a functional performance characteristic of respective reference structural features on a substrate and information elements describing physical analysis of each of said respective reference structural features, and

(ii) information elements describing feedback from said respective structural features as a function of position over each of said respective reference structural features,

(b) information elements in a computer-readable medium corresponding to at least one weighting function as a function of position over each of said respective reference structural features, and at least one correlation function as a function of position over each of said respective reference structural features, wherein a plurality of weighting functions and/or correlation functions is provided,

(c) means for determining a combination of weighting function and correlation function from said provided which provide a desired degree of correlation between said information elements (i) and (ii) for respective reference structural features,

(d) information elements in a computer-readable medium describing feedback from said target structural features as a function of position over each of said respective target structural features on said substrate,

(e) means for applying said combination of weighting function and correlation function to said target structural feature information elements to predict said functional performance characteristic of respective target structural features and/or to describe said physical characteristic of respective target structural features.

26. The system of claim 25 wherein said means (c) comprises executable code stored in a computer readable medium and a computer capable of executing said code.

27. The system of claim 25 wherein said means (e) comprises executable code stored in a computer readable medium and a computer capable of executing said code.

28. An apparatus for evaluation of target structural features on a substrate, said apparatus comprising:

(a) information elements in a computer-readable medium describing feedback from said target structural features as a function of position over each of said respective target structural features on said substrate,

(b) means for applying a combination of weighting function and correlation function to said target structural feature information

elements to predict a functional performance characteristic of respective target structural features and/or to describe a physical characteristic of respective target structural features.

29. The apparatus of claim 28 further comprising means for obtaining said information elements.

30. The apparatus of claim 29 wherein said means for obtaining said information elements includes a scanning electron beam.

31. A computer program stored in a computer-readable medium, said program performing a method of evaluating target structural features on a substrate, said method comprising:

(a) creating a calibration database comprising:

(i) information elements selected from the group consisting of (A) information elements describing a functional performance characteristic of respective reference structural features on a substrate, and (B) information elements describing a physical characteristic of each of said respective reference structural features, or both types of information elements, and

(ii) information elements describing feedback from said respective reference structural features as a function of position over each of said respective reference structural features,

(b) providing at least one weighting function as a function of position over each of said respective reference structural features and at least one correlation function as a function of position over each of said respective reference structural features, wherein a plurality of weighting functions and/or correlation functions is provided,

(c) determining a combination of weighting function and correlation function from said provided which provide a desired degree of correlation between said information elements (i) and (ii) for respective reference structural features,

(d) obtaining information elements describing feedback from said target structural features as a function of position over each of said respective target structural features on said substrate, and

(e) applying said combination of weighting function and correlation function to said target structural feature information elements to predict said functional performance characteristic of respective target structural features and/or to describe said physical characteristic of respective target structural features.

32. A computer program stored in a computer-readable medium, said program performing a method of evaluating target structural features on a substrate, said method comprising:

(a) obtaining information elements describing feedback from said target structural features as a function of position over each of said respective target structural features on said substrate,

(b) applying a combination of a weighting function and a correlation function to said target structural feature information elements to predict a functional performance characteristic of respective target structural features and/or to describe a physical characteristic of respective target structural features.

33. The method of claim 6 wherein said physical characteristic is a depth profile across said structural feature and said functional performance characteristic is etchability across said structural feature.

34. The system of claim 25 wherein said physical characteristic is a depth profile across said structural feature and said functional performance characteristic is etchability across said structural feature.

35. The computer program of claim 31 wherein said physical characteristic is a depth profile across said structural feature and said functional performance characteristic is etchability across said structural feature.

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TRANSMITTAL OF APPEAL BRIEF (Large Entity)	Docket No. FIS920010256US1

In Re Application Of:

Eric P. Solecky et al.

Serial No.	Filing Date	Examiner	Group Art Unit
09/996,399	November 29, 2001	Tung S. Lau	2863

Invention:

APPARATUS AND METHOD FOR CHARACTERIZING FEATURES AT SMALL DIMENSIONS

TO THE COMMISSIONER FOR PATENTS:

Transmitted herewith in triplicate is the Appeal Brief in this application, with respect to the Notice of Appeal filed on

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Signature

Dated: **March 18, 2004**

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Group Art Unit 2863

In re application of	:	March 18, 2004
Eric P. Solecky et al.	:	Examiner: Tung S. Lau
Serial No.: 09/996,399	:	
Filed: November 29, 2001	:	IBM Corporation Dept. 18G/Bldg, 300-482
Title: APPARATUS AND METHOD FOR CHARACTERIZING FEATURES AT SMALL DIMENSIONS	:	2070 Route 52 Hopewell Junction, NY 12533-6531

APPEAL BRIEF

Commissioner for Patents
Alexandria, VA 22313-1450

Sir:

This is an appeal from the Final Rejection of claims 6-7, 9-15 and 17-35. A correct copy of the claims is attached in the Appendix.

Real Party in Interest

The real parties in interest is International Business Machines Corporation per an assignment recorded in the US Patent and Trademark Office at Reel/Frame: 012340/0450 on November 29, 2001.

Related Appeals and Interferences

None.

Status of Claims

Claims 6-35 are pending. Claims 8 and 16 are objected to as being dependent on rejected base claims, but would be allowable if rewritten in indepenedejnt form.

Status of Amendments

No amendments after Final Rejection have been submitted.

Summary of Invention

The invention centers on methods, systems, apparatus and computer programs for providing improved resolution and prediction of performance behavior and/or physical characteristic of structural features using feedback information which is provided as a function of position over respective features. The invention is especially important in the improvement and extension of resolution capability for CD-SEM measurements to dimensions below 180 nanometers. Thus, for example, the invention is useful for better determining whether a hole in a resist pattern for forming contacts is truly open thereby improving yield and process condition discrimination. See the specification at page 2, lines 15-22; page 3, lines 2-6; page 4, lines 4-19 and the disclosure of US Patent 6185323 which is incorporated into the present application by reference.

Issues

1. Whether claims 6-7, 9-15, 17-32 are patentable under 35 USC 102(e) over Kikuchi (US Patent Application 2002/0042664).

2. Whether claims 33-35 are patentable under 35 USC 103(a) over Kikuchi (US Pat. App. 2002/0042664) in view of Kim (US Pat. 6,581,023).

Grouping of Claims

Regarding issue 1, claims 11, 13, 20, and 22 are further separately patentable for the reasons stated below and claims 15, 24, and 30 are also further separately patentable. Otherwise, the claims stand or fall together within each respective issue identified above.

Argument

1. **Whether claims 6-7, 9-15, 17-32 are patentable under 35 USC 102(e) over Kikuchi (US Patent Application 2002/0042664).**

Kikuchi discloses a process for improved overlay metrology wherein the position of alignment marks are determined and weighted to account for linear and non-linear distortion between respective shots.

Kikuchi does not disclose or suggest use of feedback elements from said features which vary as a function of position over such features as required by the present claims in both the calibration database and in the data provided from the target features. The portions of Kikuchi (page 3, 30-36 and Fig. 7, 8, 10, 11, 14, 15, 18) cited in the office action refer to distortion in the wafer as reflected by the position of the target features. These portions of Kikuchi do not relate to any property of the features themselves which changes as a function of position over the features. Kikuchi is simply concerned with feature position which is then

correlated to wafer distortion.

Kikuchi does not disclose the prediction of etchability as in present claims 11, 13, 20, and 22. The portions of the specification (page 2-3 sections 0025-0030) cited in the office action are silent regarding etchability, much less etchability of target features. Kikuchi is concerned with overlay misalignment resulting from wafer distortion. Kikuchi is not concerned whether a pattern can be actually transferred to an underlying layer, but only that whatever pattern one is attempting to transfer is aligned as correctly as possible.

Kikuchi does not disclose or suggest the use of SEM secondary electron emission as required by present claims 15, 24, and 30. Regarding method claims 15 and 24, appellants submit that no where is it contemplated in Kikuchi to use SEM data in the Kikuchi process. Thus, a process claiming to use such SEM data would not be considered obvious from Kikuchi. Regarding apparatus claim 30, appellants submit that apparatus claim requires a scanning electron beam means for obtaining information elements. Nothing in Kikuchi discloses or suggests an apparatus with such means.

2. **Whether claims 33-35 are patentable under 35 USC 103(a) over Kikuchi (US Pat. App. 2002/0042664) in view of Kim (US Pat. 6,581,023).**

Kikuchi discloses a process for improved overlay metrology wherein the position of alignment marks are determined and weighted to account for linear and non-linear distortion between respective shots.

Kikuchi does not disclose or suggest use of feedback elements from said features which vary as a function of position over such features as required by

the present claims in both the calibration database and in the data provided from the target features. The portions of Kikuchi (page 3, 30-36 and Fig. 7, 8, 10, 11, 14, 15, 18) cited in the office action refer to distortion in the wafer as reflected by the position of the target features. These portions of Kikuchi do not relate to any property of the features themselves which changes as a function of position over the features. Kikuchi is simply concerned with feature position which is then correlated to wafer distortion.

Kikuchi does not disclose the prediction of etchability as in present claims 33-35. The portions of the specification (page 2-3 sections 0025-0030) cited in the office action are silent regarding etchability, much less etchability of target features. Kikuchi is concerned with overlay misalignment resulting from wafer distortion. Kikuchi is not concerned whether a pattern can be actually transferred to an underlying layer, but only that whatever pattern one is attempting to transfer is aligned as correctly as possible.

Kim (US 6581023) discloses a method of critical dimension measurement using an SEM. The problem addressed by Kim relates to whether individual features are imaged to target critical dimensions in a lithography process on a per layer basis. Kim is not concerned with overlay metrology or overlay alignment which is the subject of Kikuchi. Even if one were to use the measurement techniques of Kim in the method of Kikuchi, the result would be a disregard of any data regarding parameters such as feature depth since Kikuchi is only concerned with the location of target features. Thus, the combination of the teachings of Kim with those of Kikuchi, to the extent such a combination would be motivated to those of ordinary skill in the art, would not result in the claimed invention.

Conclusion

For the above reasons, appellants submit that the claims are patentable over the prior art of record and that the application is in condition for allowance. Such allowance is earnestly and respectfully solicited.

Respectfully submitted,
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THE CLAIMS

1 -5. (cancelled)

6. A method for evaluation of target structural features on a substrate, said method comprising:

(a) providing a calibration database comprising:

(i) information elements selected from the group consisting of (A) information elements describing a functional performance characteristic of respective reference structural features on a substrate, and (B) information elements describing a physical characteristic of each of said respective reference structural features, or both types of information elements, and

(ii) information elements describing feedback from said respective reference structural features as a function of position over each of said respective reference structural features,

(b) providing at least one weighting function as a function of position over each of said respective reference structural features and at least one correlation function as a function of position over each of said respective reference structural features, wherein a plurality of weighting functions and/or correlation functions is provided,

(c) determining a combination of weighting function and correlation

function from said provided which provide a desired degree of correlation between said information elements (i) and (ii) for respective reference structural features,

(d) providing information elements describing feedback from said target structural features as a function of position over each of said respective target structural features on said substrate, and

(e) applying said combination of weighting function and correlation function to said target structural feature information elements to predict said functional performance characteristic of respective target structural features and/or to describe said physical characteristic of respective target structural features.

7. The method of claim 6 wherein a plurality of weighting functions and a plurality of correlation functions are provided in step (b).

8. The method of claim 6 wherein said weighting functions are selected from the group consisting of continuous functions and discontinuous functions.

9. The method of claim 6 wherein a value of said weighting function of said determined combination of step (c) is multiplied with a value of a respective information element in step (e).

10. The method of claim 6 wherein said calibration database includes information elements describing a functional performance characteristic of respective reference structural features on a substrate, and said functional performance characteristic is predicted in step (e).

11. The method of claim 10 wherein said functional performance characteristic is the etchability across said target feature.

12. The method of claim 6 wherein said structural features are holes in a resist layer on said substrate.

13. The method of claim 12 wherein said functional performance characteristic is a response of each respective hole to an etching protocol.

14. The method of claim 6 wherein all of said information elements are embodied in a computer-readable medium and steps (c) and (e) are performed using a computer.

15. The method of claim 6 wherein said feedback of steps (a) and (e) comprises secondary electron emission from said structural features upon exposure to a scanning electron beam.

16. The method of claim 6 wherein steps (c) and (e) include performance of linear regression analysis.

17. A method for evaluation of target structural features on a substrate, said method comprising:

(a) providing information elements describing feedback from said target structural features as a function of position over each of said respective target structural features on said substrate,

(b) applying a combination of a weighting function and a correlation function to said target structural feature information elements to predict a functional performance characteristic of respective target

structural features and/or to describe a physical characteristic of respective target structural features.

18. The method of claim 17 wherein a value of said weighting function is multiplied with a value of a respective information element in step (b).

19. The method of claim 17 wherein a functional performance characteristic is predicted in step (b).

20. The method of claim 19 wherein said functional performance characteristic is the etchability across said target feature.

21. The method of claim 17 wherein said structural features are holes in a resist layer on said substrate.

22. The method of claim 21 wherein said functional performance characteristic is a response of each respective hole to an etching protocol.

23. The method of claim 17 wherein all of said information elements are embodied in computer-readable media and steps (c) and (e) are performed using a computer.

24. The method of claim 17 wherein said feedback comprises secondary electron emissions from said structural features upon exposure to a scanning electron beam.

25. A system for evaluation of target structural features on a substrate, said system comprising:

(a) a calibration database in a computer-readable medium, said database comprising:

(i) information elements selected from the group consisting of information elements describing a functional performance characteristic of respective reference structural features on a substrate and information elements describing physical analysis of each of said respective reference structural features, and

(ii) information elements describing feedback from said respective structural features as a function of position over each of said respective reference structural features,

(b) information elements in a computer-readable medium corresponding to at least one weighting function as a function of position over each of said respective reference structural features, and at least one correlation function as a function of position over each of said respective reference structural features, wherein a plurality of weighting functions and/or correlation functions is provided,

(c) means for determining a combination of weighting function and correlation function from said provided which provide a desired degree of correlation between said information elements (i) and (ii) for respective reference structural features,

(d) information elements in a computer-readable medium describing feedback from said target structural features as a function of position over each of said respective target structural features on said substrate,

(e) means for applying said combination of weighting function and correlation function to said target structural feature information elements to predict said functional performance characteristic of respective target structural features and/or to describe said physical characteristic of respective target structural features.

26. The system of claim 25 wherein said means (c) comprises executable code stored in a computer readable medium and a computer capable of executing said code.

27. The system of claim 25 wherein said means (e) comprises executable code stored in a computer readable medium and a computer capable of executing said code.

28. An apparatus for evaluation of target structural features on a substrate, said apparatus comprising:

(a) information elements in a computer-readable medium describing feedback from said target structural features as a function of position over each of said respective target structural features on said substrate,

(b) means for applying a combination of weighting function and correlation function to said target structural feature information

elements to predict a functional performance characteristic of respective target structural features and/or to describe a physical characteristic of respective target structural features.

29. The apparatus of claim 28 further comprising means for obtaining said information elements.

30. The apparatus of claim 29 wherein said means for obtaining said information elements includes a scanning electron beam.

31. A computer program stored in a computer-readable medium, said program performing a method of evaluating target structural features on a substrate, said method comprising:

(a) creating a calibration database comprising:

(i) information elements selected from the group consisting of (A) information elements describing a functional performance characteristic of respective reference structural features on a substrate, and (B) information elements describing a physical characteristic of each of said respective reference structural features, or both types of information elements, and

(ii) information elements describing feedback from said respective reference structural features as a function of position over each of said respective reference structural features,

(b) providing at least one weighting function as a function of position over each of said respective reference structural features and at least one correlation function as a function of position over each of said respective reference structural features, wherein a plurality of weighting functions and/or correlation functions is provided,

(c) determining a combination of weighting function and correlation function from said provided which provide a desired degree of correlation between said information elements (i) and (ii) for respective reference structural features,

(d) obtaining information elements describing feedback from said target structural features as a function of position over each of said respective target structural features on said substrate, and

(e) applying said combination of weighting function and correlation function to said target structural feature information elements to predict said functional performance characteristic of respective target structural features and/or to describe said physical characteristic of respective target structural features.

32. A computer program stored in a computer-readable medium, said program performing a method of evaluating target structural features on a substrate, said method comprising:

(a) obtaining information elements describing feedback from said target structural features as a function of position over each of said respective target structural features on said substrate,

(b) applying a combination of a weighting function and a correlation function to said target structural feature information elements to predict a functional performance characteristic of respective target structural features and/or to describe a physical characteristic of respective target structural features.

33. The method of claim 6 wherein said physical characteristic is a depth profile across said structural feature and said functional performance characteristic is etchability across said structural feature.

34. The system of claim 25 wherein said physical characteristic is a depth profile across said structural feature and said functional performance characteristic is etchability across said structural feature.

35. The computer program of claim 31 wherein said physical characteristic is a depth profile across said structural feature and said functional performance characteristic is etchability across said structural feature.

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